INCH-POUND

MIL-PRF-1/1203K
27 August 1999
SUPERSEDING
MIL-E-1/1203J
25 May 1976

PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, NEGATIVE GRID (MICROWAVE) TYPE 7077

This specification is approved for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the electron tube described herein shall consist of this document and the latest issue of MIL-PRF-1.

DESCRIPTION: Triode, planar, metal-ceramic.
See figure 1.
Mounting position: Any.
Weight: 0.06 ounce (1.7 grams) nominal.

ABSOLUTE RATINGS:

Parameter:	F	Ef	Eb	Ebb	Ec	Ehk	Rk	Rg	Rp	Ik	Pp	TE	Barometric pressure, reduced
Unit:	MHz	V	V dc	V dc	V dc	v	Ohms	Meg	Meg	mA dc	W	°C	mm Hg
Maximum:	450	6.6	250	---	0, -50	50	---	0.01 1/	---	11.0	1.1	250 2/	8
Mininum:	---	6.0	---	---	---	---	---	---	---	---	---	---	---
Test conditions:	---	6.3	---	250	0	---	82	---	0.018	---	---	---	---

See footnotes at end of table I.

GENERAL: Qualification - Required.

TABLE I. Testing and inspection.

Inspection	Method	Notes	Conditions	Acceptance Level 14/	Symbol	Limits Min	Limits Max	Unit
Qualification inspection								
Barometric pressure, reduced	1002	---	Pressure = 8 ± 1 mmHg; 300 V ac applied between grid and anode	---	---	---	---	---
Sweep-frequency vibration	1031	11/	Ebb = 150 V dc; Rp = 10,000 ohms; 10 G; F = 100 to 5,000 Hz	---	Ep	---	15	mV ac
Sweep-frequency vibration fatigue	1031	12/	Eb = Ec = 0; Ef = 6.3 V	---	---	---	---	---
Sweep-frequency vibration-fatigue test end points:								
Low-frequency vibration	1031	---		---	Ep	---	15	mV ac
Heater-cathode leakage	1336	---		---	Ihk	---	20	µA dc
Noise figure (1)	---	---		---	NF	---	8.1	dB
Power gain	---	---		---	Gain	11.5	---	dB
Conformance inspection, part 1								
Heater current	1301	---		0.65	If	222	258	mA
Heater-cathode leakage	1336	---		0.65	Ihk	---	20	µA dc
Noise figure (1)	---	3/	F = 450 MHz; Cp = 500 pF	0.65	NF	---	6.6	dB
Power gain	---	4/	F = 450 MHz; Cp = 500 pF	0.65	Gain	12.5	---	dB
Short and discontinuity detection	1201	---		0.65	---	---	---	---
Conformance inspection, part 2								
Insulation of electrodes	1211	---		---	R	100	---	Meg
Electrode current (anode)	1256	---		---	Ib	5.2	8.8	mA dc
Grid emission	1266	6/	Ef = 7.0 V; Ecc = -20 V dc; Rg = 0.1 Meg	---	Ic	0	-2.0	µA dc
Grid recovery	2210	5/	Ebb = 250 V dc; Ec/Ib = 3.0 mA dc; Rp = 10 K ohms	---	ΔIb Δib	--- ---	0.6 1.0	mA dc ma

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	Method	Notes	Conditions	Acceptance Level 14/	Symbol	Limits Min	Limits Max	Unit
Conformance inspection, part 2 - Continued.								
Transconductance (1)	1306	---	Cp = 4 µF; Ck = 1,000 µF	---	Sm	7,000	13,000	µmhos
Transconductance (2)	1306	---	Ef = 6.0 V; Cp = 4 µF; Ck = 1,000 µF	---	ΔSm / Ef	---	20	%
Noise figure (2)	---	3/	Ef = 6.0 V; F = 450 MHz; Cp = 500 pF	---	NF	---	8.1	dB
Amplification factor	1316	---		---	Mu	65	115	---
Direct-interelectrode capacitance	1331	---	DSCC Drawing 67030	---	Cgp Cin Cout Chk	1.06 1.20 0.005 0.80	1.36 2.10 0.015 1.40	pF pF pF pF
Envelope strain	---	7/		---	---	---	---	---
Low-frequency vibration	1031	10/	Ebb = 150 V dc; Rp = 10,000 ohms; 15 G; F = 40 Hz	---	Ep	---	10	mV ac
Conformance inspection, part 3								
Heater-cycling life	1506	8/	Ef = 7.0 V; Ehk = 70 V dc; Rk = 0; Ec = Eb = 0	---	---	---	---	---
Heater-cycling life-test end point:	---							
Heater-cathode leakage	1336	---		---	Ihk	---	40	µA dc
Stability life	1516	---	Ebb = 300 V dc; Ehk = 70 V dc; Rb = 0.018 Meg; Rk = 82 ohms; Rg = 0.01 Meg	2.5	---	---	---	---
Stability life-test end point:	---							
Change in transconductance (1) of individual tubes	---	---		---	ΔSm / t	---	15	%
Intermittent life (1)	1501	9/	Group A; stability-life test, or equivalent conditions; t = 1,000 hours	---	---	---	---	---

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	Method	Notes	Conditions	Acceptance Level 14/	Symbol	Limits		Unit
						Min	Max	
Conformance inspection, part 3 - Continued.								
Intermittent life (2)	1501	9/ 10/ 11/ 12/ 13/	Stability-life test, or equivalent conditions, except TE = 250°C (min); t = 1,000 hours	---	---	---	---	---
Intermittent life-test end points:	---							
Heater current	1301	---		---	If	222	264	mA
Noise figure (1)	---	---		---	NF	---	8.6	dB
Noise figure (2)	---	---		---	NF	---	10.5	dB
Power gain	---	---		---	Gain	11.0	---	dB
Heater-cathode leakage	1336	---		---	Ihk	---	20	µA dc
Insulation of electrodes	1211	---		---	R	50	---	Meg
Transconductance (1)	1306	---		---	Sm	6,000	---	µmhos
Shock	1041	13/	Hammer angle = 30°; Ehk = 50 V dc; Eb = 150 V dc; Rp = 0	---	---	---	---	---
Shock-test end points								
Low-frequency vibration	1031	---		---	Ep	---	15	mV ac
Heater-cathode leakage	1336	---		---	Ihk	---	20	µA dc
Noise figure (1)	---	---		---	NF	---	8.1	dB
Power gain	---	---		---	Gain	11.5	---	dB

1/ At anode temperature below 150°C, Rg may be increased to 0.1 Meg.

2/ Envelope temperature is defined as the temperature measured at the periphery of the anode.

3/ Noise figure test.

a. Definition. The noise figure of the system shall be defined as 10 log $\frac{32.4}{Y-1}$, where 32.4 is the excess noise temperature of the noise generator, expressed as power ratio, and Y is the ratio of the noise power output of the system with the noise generator "on" to the noise power output of the system with the noise generator "off". The specified test limits refer to the noise figure of the tube under test (TUT) which is the noise figure of the system corrected for the noise figure of the noise amplifier and of the first stage.

The first stage noise figure is calculated with the formula:

$F_1 = F_{1-2} - \frac{(F_2 - 1)}{G_1}$ where F_1 is the noise figure of the first stage, F_2 is the noise figure of the noise figure amplifier, F_{1-2} is the measured noise figure of the overall systems (all noise figures being expressed as power ratios rather than in decibels) and G_1 is the average gain of the TUT expressed as a power ratio.

b. Test procedure. Measurement of noise figure is made by noting the noise power in the calibrated power indicator both with the noise generator switched "on" and with it switched "off", using the equipment shown on figure 2.

c. Noise generator. An Airborne Instrument Laboratory Argon Lamp Noise Generator, Model 70, or equivalent.

TABLE I. Testing and inspection - Continued.

d. Four hundred and fifty MHz test amplifier. An amplifier consisting of the TUT with related circuits shown on figure 3.

(1) The cathode cavity shall be of sufficient quality to maintain an unloaded Q of over 150 measured at the amplifier input with the tube removed and a low-loss dummy-tube capacitor having a value within the range specified for input capacitance inserted in its place. The heater circuit shall also be a component part of the cathode cavity such that the unloaded Q will reflect any loss in input power due to the heater circuit. The cathode cavity and its components shall provide a power match between the coaxial input and the cathode of the TUT.

(2) The anode cavity shall be of sufficient quality to maintain an unloaded Q in excess of 600 measured with the TUT replaced with a low-loss dummy-tube capacitor having a value within the range specified herein for output capacitance. The anode cavity shall be capable of resonating all tubes having output capacitance within the limits specified herein. An appropriate coupling loop or probe shall be provided to load the anode cavity in order to maintain an overall amplifier bandwidth of 7.5 MHz when connected to its 50-ohm load.

(3) The design of the tube contacting components shall provide for firm and consistent contacts to all tube terminals. Sufficient shielding between input and output circuits of the amplifier shall be provided so that no indication is obtained on the power gain test indicator when the dummy-type capacitor is substituted for the TUT and full signal is applied. Both input and output resonant circuits shall be tuned to 450 MHz for shielding test.

e. Four hundred and fifty MHz noise amplifer. The amplifier shall have the following characteristics:

Center frequency:	450 MHz
Bandwidth:	2.0 MHz
Input VSWR from 50 ohms:	Less than 1.1
Noise figure:	Less than 6 dB (using Airbome Instrument Laboratory Argon Lamp Noise Generator, Model 70, or equivalent.
Power gain:	Approximately 80 dB (shall be adjustable from 70 to 80 dB). The output shall be adjusted to work into a calibrated 50-ohm load and shall be matched to a VSWR less than 1.2:1 looking into noise amplifier output.

f. Detector and 50-ohm load. The detector and load shall be the equivalent of the General Radio 874 VQ detector terminated in a 50-ohm load (General Radio 874 WM). A calibration curve shall be plotted to accurately establish the relation between rf power into the detector and the detector crystal current as indicated on the microampere meter. The calibration curve is used to accurately determine the Y factor in the noise figure equation.

g. Microampere meter. A Greibach, Model 500, Microampere Meter, or equivalent.

h. Dummy-tube capacitor. A dummy-tube capacitor is a capacitor used in checking the test equipment and in making the test for adequate shielding between input and output circuits of the 450 MHz test amplifier TUT. Physical dimensions of the capacitor shall be the same as for the tube except that the heater pins and the heater-to-cathode ceramic are omitted. Construction shall be as shown on figure 4.

4/ Power gain test.

a. The power gain test shall be performed in the equipment as shown on figure 5.

(1) Calibrated signal generator: General Radio Model 1021-P2, or equivalent.

(2) Four hundred and fifty MHz noise amplifier: Same as specified for noise figure tests. (See 3/ e).

(3) Detector and 50-ohm load: Same as specified for noise figure test. (See 3/ f).

(4) Microampere meter: Same as specified for noise figure test. (See 3/ g).

b. Procedure. With signal generator switched directly into detector and 50-ohm load, adjust output for approximate midscale indication on microampere meter and note output, P1 (calibrated in decibels), from signal generator. Switch 450-MHz test amplifier into circuit with tube inserted and reduce signal generator output until the same approximate midscale indication is again obtained on the microampere meter and note the signal generator output, P2. Power gain = P1 - P2.

TABLE I. Testing and inspection - Continued.

5/ Grid recovery. Test shall be performed as follows:

a. With TUT operating under specified conditions, adjust Ec for Ib = 3 mA dc.

b. Apply 5 volt pulse, 20 µs duration, 60 pps to the grid.

c. With application of pulse, measure undershoot (Δib) and change in average current (ΔIb).

6/ Prior to this test, tubes shall be preheated for a minimum of 5 minutes at the conditions indicated below. The 3-minute test is not permitted. Test within 3 seconds after preheating.

Ef	Ecc	Ebb	Rk	Rg	Rp
V	V dc	V dc	Ohms	Meg	Meg
7.0	0	250	82	0.1	0.018

7/ Envelope strain procedure. Tubes shall be tested as specified in method 2126, except that they shall be immersed in water at not more than 5°C for 15 seconds and immediately thereafter subjected to the standard temperature cycle specified in method 2126. The criteria for air leaks shall be heater current of 300 mA, or more.

8/ The heater-cycling life-test sample shall consist of 15 tubes and no tube failure shall be permitted. In the event of rejection of the first sample due to failure of 1 tube, a second sample of 15 tubes shall be selected from the lot. Acceptance shall then be based on the combined first and second samples. The total tube failures from the combined first and second samples shall not exceed one.

9/ Intermittent life. The specified life-test end points shall be applied to both the intermittent life-test (1) and (2) test samples with the exception of noise figure and power gain measurements, which shall be performed on the intermittent life-test (1) samples only.

10/ Low-frequency vibration. Test shall be performed as follows: The tube shall be vibrated with simple harmonic motion in each of two planes; first, parallel to the cylindrical axis; second, perpendicular to the cylindrical axis and parallel to a line through the heater contacts.

11/ Sweep-frequency vibration. Test shall be performed as follows:

a. The frequency shall be increased from 100 to 5,000 Hz with approximately logarithmic progression in 3 ± 1 minutes. The return sweep (5,000 to 100 Hz) is not required.

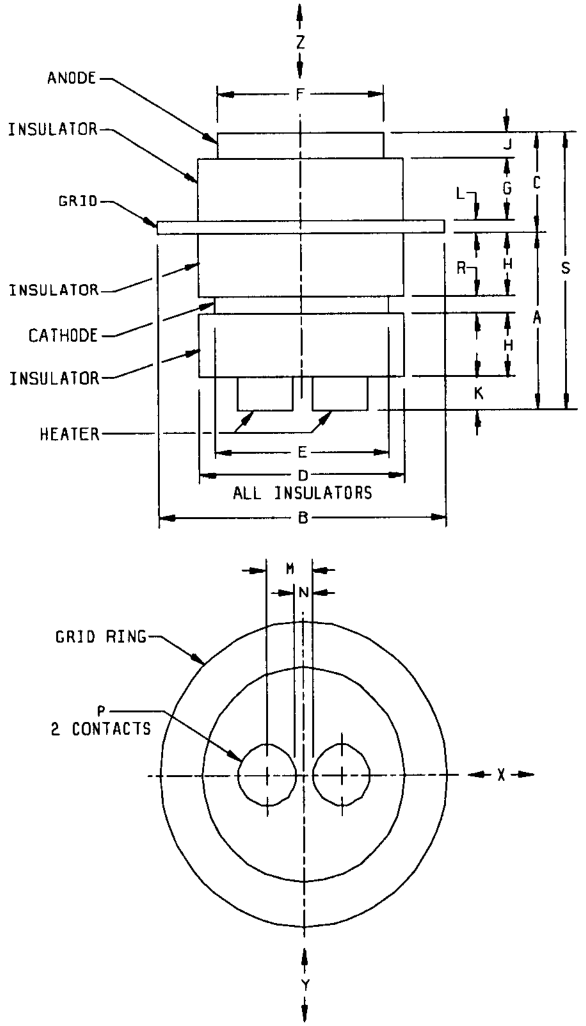
b. The tube shall be vibrated with simple harmonic motion in each of two planes; first, parallel to the cylindrical axis; second, perpendicular to the cylindrical axis and parallel to a line through the heater contacts.

c. The value of alternating voltage, Ep, produced across the resistor, Rp, as a result of vibration shall be measured with a suitable device having a response to the rms value of a sine wave of voltage to within ± 0.5 dB of the response at 100 Hz over the frequency range of 50 to 5,000 Hz and having a frequency cutoff such that the response is down a minimum of 12 dB at 10,000 Hz. The meter shall have a dynamic response characteristic equivalent to, or faster than, a VU meter (operated in accordance with Acoustical Society of America Standards No. C16.5-1954).

12/ Sweep-frequency vibration fatigue. Test shall be performed as specified in method 1031, except that the tubes shall be vibrated for a total of 6 hours, that is, 3 hours in each of two directions: First, parallel to the cylindrical axis; second, perpendicular to the cylindrical axis and parallel to a line through the heater contacts.

13/ This test shall be performed during the initial production and once each succeeding 12-calendar months in which there is production. A regular double sampling plan shall be used, with the first sample of three tubes with an acceptance number of zero, and a second sample of three tubes with a combined acceptance number of one. In the event of failure, the test will be made as a part of conformance inspection, part 2, with an acceptance level of 6.5. Acceptance shall be based upon accept on zero (c = 0) sampling plan in accordance with Table III of MIL-PRF-1. The regular "12-calendar month" double sampling plan shall be reinstated after three consecutive samples have been accepted.

14/ Acceptance shall be based upon accept on zero (c = 0), in accordance with Table III of MIL-PRF-1.



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection, part 1 (see note 5)				
A	.268	.292	6.81	7.42
B	.476	.484	12.09	12.29
C	.156	.174	3.96	4.42
D	---	.335	---	8.51
E	.281	.289	7.14	7.34
F	.271	.279	6.88	7.09
G	.094	.104	2.39	2.64
H	.095	.105	2.41	2.67
J	.034	.046	0.86	1.17
K	.047	.063	1.19	1.60
L	.024	.030	0.61	0.76
M	.055	.081	1.40	2.06
N	.030	---	0.76	---
P	.086	.094	2.18	2.39
R	.022	.028	0.56	0.71
S	.430	.460	10.92	11.68

NOTES:

1. Eccentricity of anode, grid, and cathode with respect to centerline shall be .005 inch (0.13 mm) maximum.
2. Eccentricity of insulators with respect to centerline shall be .010 inch (0.25 mm) maximum.
3. Centerline of grid shall be reference line for horizontal tolerances.
4. Bottom surface of grid shall be reference plane for vertical tolerances.
5. The acceptance level for dimensions listed under conformance inspection, part 1, shall be 1.0. Acceptance shall be based upon accept on zero (c = 0) sampling plan in accordance with Table III of MIL-PRF-1.

FIGURE 1. Outline drawing of electron tube type 7077.

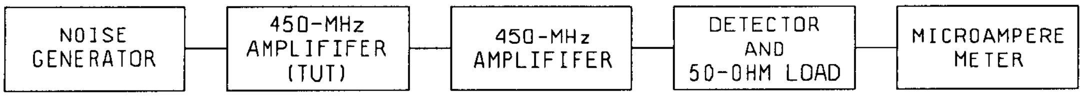


FIGURE 2. Equipment set up for noise figure test.

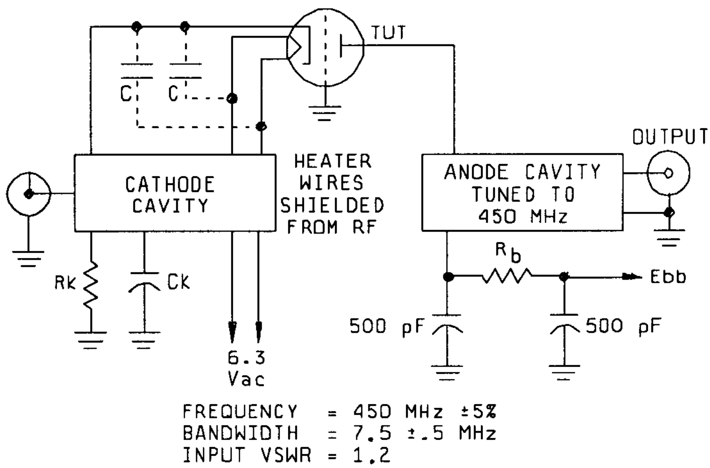


FIGURE 3. 450 MHz test amplifier.

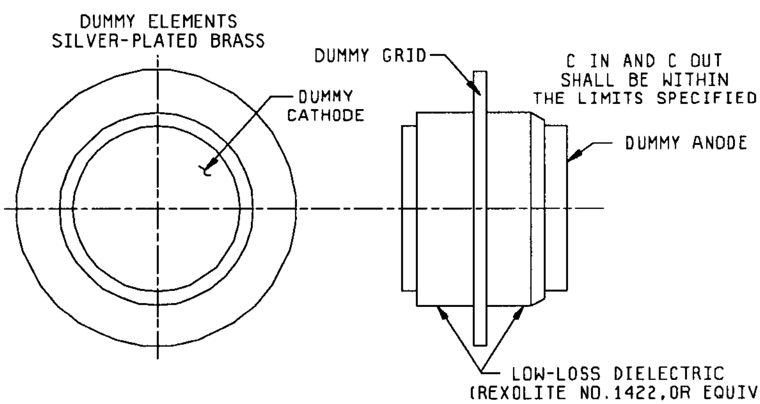


FIGURE 4. Construction of 'dummy-tube" capacitor.

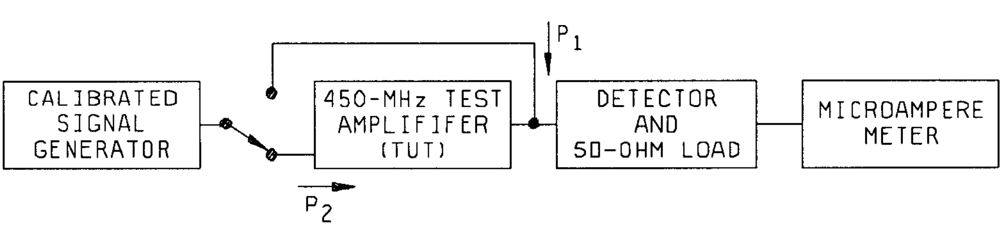


FIGURE 5. Equipment set up for power gain test.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Review activities:
Army - MI
Navy - AS, CG, MC, OS

Preparing activity:
DLA - CC

(Project 5960-3531)